

Nine new species of *Calothamnus* Labill. (Myrtaceae: Leptospermoideae) from Western Australia

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Abstract

Hawkeswood, T. J. Nine new species of *Calothamnus* Labill. (Myrtaceae: Leptospermoideae) from Western Australia. Nuytsia 5(1): 123-153 (1984). Nine new species and one new subspecies of *Calothamnus* from Western Australia are described, namely *C. graniticus*, *C. tuberosus*, *C. formosus*, *C. formosus* subsp. *rigidus*, *C. hirsutus*, *C. brevifolius*, *C. aridus*, *C. macrocarpus*, *C. kalbarriensis* and *C. borealis*. A new combination, *C. graniticus* subsp. *leptophyllus*, is also provided, based on *C. torulosus* Schau. var. *leptophylla* Benth. The affinities of the new species are considered. In addition, a key is provided to all species of *Calothamnus* presently recognized.

Introduction

The author is presently revising the genus *Calothamnus* Labill., a group of myrtaceous plants endemic to Western Australia. Since it will be some time before the revision is complete, this paper provides descriptions of the new species and a key to the presently recognized specific and subspecific taxa. Existing keys and other taxonomic data on the genus have proved to be inadequate, and this has resulted in many misidentifications in survey work publications.

Calothamnus is currently classified with *Beaufortia*, *Regelia*, *Phymatocarpus* and *Eremaea* in a subtribe named Beaufortiinae (Bentham 1867) or Calothamniinae (Niedenzu 1898), or in a group informally named "*Calothamnus* infra-alliance" (Briggs and Johnson 1979). Among these genera *Calothamnus* is closest in floral morphology to *Beaufortia*, and it also resembles *Lamarchea* (of the neighbouring "*Melaleuca* infra-alliance" in the classification of Briggs and Johnson 1979) in leaf anatomy (Hawkeswood 1978 and in prep.) and floral features. From *Lamarchea* it differs most strikingly in having erect, basifixed anthers and from *Beaufortia* in having more than one ovule per locule and anthers dehiscing by longitudinal slits.

The generic characteristics include the following morphological features. Mostly medium-sized to tall woody shrubs, occasionally low-growing. Leaves usually crowded, linear or sometimes oblanceolate, usually glabrous when mature, oil glands prominent. Flowers sessile, in small clusters or dense (often unilateral) spikes on older stems from which the leaves have fallen, or amongst leaves (but not necessarily axillary); calyx-tube somewhat campanulate, glabrous or pubescent, often immersed in the stems; calyx-lobes deltoid, usually thick with scarious margins, sometimes all or few persistent; petals 4 or 5, obovate to elliptical, usually deciduous; staminal claws 4 or 5, equal or unequal (sometimes upper two fused and lower ones reduced as in *C. sanguineus* Labill.), crimson to deep purple-red (yellow-brown in *C. pachystachyus* Benth.), usually with numerous filaments; ovary inferior, 3-celled; ovules numerous. Fruit a sessile capsule, depressed globular to ovoid; calyx-lobes absent or present; seeds linear to narrow-obovoid, 1-4 mm long, usually darker in colour than the numerous ovulodes.

The group is popularly known as “one-sided bottlebrushes”, but this is a misnomer since most of the species have cylindrical spikes or scattered flowers on all sides of the stem.

The genus is clearly divided into two groups, 4-merous and 5-merous species. Within each group the species are here arranged systematically.

In addition to the usual herbarium acronyms (Holmgren, Keuken and Schofield 1981), KP has been used for herb. Kings Park Botanic Garden, Perth. Where a herbarium holds more than one sheet of a collection, this has been indicated by the relevant number in brackets after the specimen's citation.

For some of the species described herein, not every specimen seen by the author has been cited. In these cases, specimens with no collection data have not been cited but have been included in the figure for total number of specimens seen.

The term “calyx-tube” has been adopted in this paper and follows the terminology of Bentham (1867) since there appears to be little agreement amongst modern authors on the correct use of terms to describe this floral structure and its associated appendages.

Key to the species of *Calothamnus*

- | | | |
|-----|---|---------------------------------|
| 1. | Flowers 4-merous | 2 |
| 1.* | Flowers 5-merous | 22 |
| 2. | Two upper staminal claws broad, flat; two lower ones narrow..... | 3 |
| 2.* | Staminal claws all narrow | 6 |
| 3. | Calyx-tube (at time of flowering) entirely immersed in the thick, swollen rhachis..... | 4 |
| 3.* | Calyx-tube (at time of flowering) not immersed in the rhachis (rhachis not prominently swollen) | 5 |
| 4. | Leaves flat, 8-15 cm long (Mogumber, Moora area)..... | <i>C. pachystachyus</i> Benth. |
| 4.* | Leaves terete, 15-30 cm long (Eneabba area)..... | <i>C. longissimus</i> F. Muell. |
| 5. | Two upper staminal claws fused; anthers glabrous; leaves mostly 1-2 cm long, terete or biconvex in transection, usually with numerous spreading hairs; shrub 30-80 cm high (Cape Naturaliste to Kalbarri) | <i>C. sanguineus</i> Labill. |
| 5.* | Two upper staminal claws free; anthers covered in long, cobweb-like hairs; leaves mostly 2-4 cm long, terete, with few spreading hairs (or glabrous), somewhat scabrous; shrub 20-45 cm high (Perth to Eneabba) | <i>C. torulosus</i> Schau. |
| 6. | Calyx-tube (at time of flowering) \pm immersed in the swollen rhachis or rhachis somewhat dilated at base of calyx-tube..... | 7 |
| 6.* | Calyx-tube (at time of flowering) not immersed in the rhachis..... | 13 |
| 7. | Rhachis swollen (leaves terete, (3)7-10(30) cm long; flowers in unilateral spikes 4-10 cm long—Perth, along south-west coast to Albany and Stirling Range) | <i>C. lateralis</i> Lindl. |
| 7.* | Rhachis not swollen | 8 |

8. Leaves flat9
- 8.* Leaves terete10
9. Leaves with two longitudinal grooves both adaxially and abaxially (Stirling Range)*C. microcarpus* F. Muell.
- 9.* Leaves without grooves (Pingelly to Albany)*C. planifolius* Lehm.
10. Staminal claws more than 1.5 cm long11
- 10.* Staminal claws less than 1 cm long12
11. Staminal claws \pm equal with 5 filaments; shrub to 2 m high (Stirling Range)*C. affinis* Turcz.
- 11.* Staminal claws not equal, the two upper ones with 3-5 filaments, the lower ones with 1 or 2 filaments; shrub to 40 cm high (Tutanning Reserve, Cranbrook, Frankland)*C. preissii* Schau.
12. Leaves 10-20 cm long; staminal claws \pm equal, each with 2-4 filaments (Stirling Range, Mt Barker)*C. schaueri* Lehm.
- 12.* Leaves 1-2.5 cm long; staminal claws not equal, the two upper ones with 4 or 5 filaments, the lower ones reduced to a single stamen (Bowelling to the Stirling Range)*C. lehmannii* Schau.
13. Fruit retaining all 4 lobes (two of which are reflexed and prominently thickened, the other ones less thickened, deflexed)14
- 13.* Fruit retaining 2 lobes which are prominently thickened and reflexed (or fruit very shortly 4-lobed)15
14. Leaves short, mostly 2-2.5 cm long, stiff, pungent; calyx-tube densely pubescent; fruit mostly 15-20 mm long, 13-18 mm wide (Red Hill, Gosnells, Boyagin Rock)*C. rupestris* Schau.
- 14.* Leaves long, (4)5-7(8) cm long, shortly mucronate; calyx-tube usually glabrous; fruit mostly 16-18 mm long, 12-15 mm wide (Cape Naturaliste, Dwellingup, Collie)1. *C. graniticus* T. J. Hawkeswood
15. Fruit shortly 4-lobed (leaves 8-12 cm long, glaucous; fruit depressed globular, 5-7 mm wide—Peak Charles, Knapp Rock, Barbalin Rock, Spinifex Rock)2. *C. tuberosus* T. J. Hawkeswood
- 15.* Fruit with two prominently thickened lobes16
16. Leaves pungent, rigid, densely crowded (flowers hidden by the dense foliage—Mt Barren Range)*C. pinifolius* F. Muell.
- 16.* Leaves not pungent17
17. Flowers usually 2-5(8) together in a small cluster amongst leaves18
- 17.* Flowers usually arranged in a dense spike21
18. Leaves flat19
- 18.* Leaves terete20
19. Leaves mostly 1.5-2 cm long, 1.4-2 mm wide, narrowly oblanceolate (Wongan Hills)*C. asper* Turcz.
- 19.* Leaves mostly 2-4 cm long, 3-8 mm wide, usually oblanceolate*C. homalophyllus* F. Muell.
20. Calyx-tube densely hirsute; flowers 3-5 in a cluster (Cape Riche)*C. robustus* Schau.
- 20.* Calyx-tube usually glabrous, (sometimes finely pubescent); flowers mostly 3 together in a cluster (Mt Barren Range)*C. validus* S. Moore
21. Leaves mostly oblanceolate (sometimes narrowly oblanceolate), glabrous (Geraldton to the Kalbarri National Park)*C. homalophyllus* F. Muell.
- 21.* Leaves linear, usually with spreading hairs (occasionally glabrous) (Shark Bay to Cape Arid)*C. quadrifidus* R. Br.
22. Calyx-tube (at time of flowering) immersed or half immersed in the rachis23

- 22.* Calyx-tube not immersed in the rhachis (although rhachis may be slightly dilated at the base of the calyx-tube)24
23. Calyx-tube (at time of flowering) entirely immersed in the swollen, corky rhachis; fruit smooth, embedded in the rhachis (Fitzgerald River area)*C. gibbosus* Benth.
- 23.* Calyx-tube (at time of flowering) half immersed in the rhachis; fruit usually ribbed, not embedded in the rhachis (Albany to Cape Arid)*C. gracilis* R.Br.
24. Leaves flat; calyx-tube and lobes densely pubescent (lobes thickened and persistent on fruit; leaves usually scabrous—Kalbarri National Park)*C. blepharospermus* F. Muell.
- 24.* Leaves terete25
25. Fruit with short rounded protuberances (Shark Bay to Yuna)3. *C. formosus* T. J. Hawkeswood
- 25* Fruit without such protuberances, usually smooth26
26. Fruit \pm depressed globular, smooth, usually truncate (or occasionally very shortly 5-lobed)27
- 26.* Fruit not depressed globular, longer than wide32
27. Fruit usually with corky excrescences, sometimes smooth or warty28
- 27.* Fruit without corky excrescences, usually smooth or with wide, smooth ribs29
28. Leaves mostly 4-6 cm long, terete (Geraldton to Kalbarri National Park)*C. oldfieldii* F. Muell.
- 28.* Leaves mostly 1.5-2.5 cm long, terete or slightly flattened (Kalbarri to Tamala Homestead)8. *C. kalbarriensis* T. J. Hawkeswood
29. Calyx-tube glabrous (leaves mostly 2-2.5 cm long, sparsely pilose; fruit large, smooth, cylindrical to almost globular, 13-17 mm long, 13-18 mm wide—East Mt Barren)7. *C. macrocarpus* T. J. Hawkeswood
- 29.* Calyx-tube densely pubescent30
30. Leaves hirsute (mostly 2-2.5 cm long; fruit densely pubescent but becoming glabrous with age, then smooth, 5-6 mm long, 5-6 mm wide—Perth to Eneabba)4. *C. hirsutus* T. J. Hawkeswood
- 30.* Leaves glabrous31
31. Leaves mostly 8-12 mm long, fruit initially pubescent, but becoming glabrous with age, 4-5 mm long, c. 5 mm wide (Cunderdin, Tammin, Piawaning)5. *C. brevifolius* T. J. Hawkeswood
- 31.* Leaves mostly 7-10 cm long, fruit glabrous or ribbed, 4-8 mm long, 5-8 mm wide (Paynes Find, Wiluna, Sandstone) .6. *C. aridus* T. J. Hawkeswood
32. Calyx-tube glabrous (leaves 6-10 cm long, fruit 8-12 mm long—East of Geraldton through arid regions of south-west Western Australia)*C. gilesii* F. Muell.
- 32.* Calyx-tube densely pubescent33
33. Fruit truncate or very shortly 5-lobed (leaves erect, with short, appressed hairs giving them a blue-grey appearance—Learmonth, Cape Range, Coral Bay)9. *C. borealis* T. J. Hawkeswood
- 33.* Fruit not truncate, prominently 2 or 5 lobed34
34. Fruit widest at the middle, with 2 lobes prominently thickened at top of fruit (Albany to Esperance)*C. villosus* R.Br.
- 34.* Fruit widest at the base, with 5 lobes prominently thickened at top of fruit (Geraldton to the Kalbarri National Park)*C. chrysantherus* F. Muell.

Four-merous species

1. *Calothamnus graniticus* T. J. Hawkeswood, sp. nov. (Figures 1, 2, 3, 4, 11)

Frutex usque ad 2 m altus. Folia linearia, teretia, erecta, (2.5)4-8(10) cm longa, (0.4)1-1.5(2) mm lata, mucronata, glabra vel appresso pilosa. Flores 2-25, in fasciculis parvis vel spicis brevibus. Calycis tubus (5)7-8(10) mm longus, glaber, verrucosus; calycis lobi 6-8 mm longi. Petala 11-15 mm longa. Unguis staminalis 32-40 mm longus, atroroseus; filamentis marginalibus (17)20-22(25). Fructus sessilis, 15-22 mm longus. Semina 2-2.5 mm longa, atrobrunnea.

Typus: Little Meelup Beach, Cape Naturaliste area (33°32'S, 115°01'E); erect, usually compact, wide shrub to 1.5 m high; locally common; heath with *Hakea*, *Leucopogon*, *Beaufortia* species; 24 June 1979, T. J. Hawkeswood 110 (holo: PERTH; iso: CANB, MEL, NSW, PERTH).

Erect, wide, compact or sometimes spreading, single or multi-stemmed, much-branched, glabrous or slightly pubescent *shrub* to 2 m high. *Young plants* with smooth bark, *older plants* with thick stems and hard grey bark often splitting near the base of the trunk. *Young branches* glabrous or shortly pubescent. *Older stems* often with prominent leaf scars. *Leaves* sessile, linear, terete, erect, rigid or flaccid, (2.5)4-8(10) cm long, (0.4)1-1.5(2) mm wide, shortly mucronate, pungent, glabrous or clothed with closely appressed, short, white hairs; leaves scattered or densely crowded at ends of branches. *Oil glands* on leaves randomly distributed and conspicuous (especially in glabrous-leaved specimens). *Flowers* 2-25 in clusters or irregular spikes usually on portions of stems from which the leaves have fallen. *Calyx-tube* large, extended globular to broadly campanulate, (5)7-8(10) mm long, glabrous, green, somewhat verrucose; *rhachis* slightly dilated at base; *calyx-lobes* erect, glabrous outside, shortly pubescent within; two opposite lobes wider than remaining two (smaller lobes overlapped by larger ones in bud); largest lobes broadly deltoid, obtuse, slightly concave, 6-8 mm long, 5-7 mm wide, thick but with thin, scarios margins; remaining two lobes narrowly deltoid, concave, 6-8 mm long, c. 4 mm wide, thinner but with thin, fimbriate margins. *Petals* broadly ovate, obtuse, concave, glabrous, 6-7(8) mm long with a claw 5-7 mm long. *Staminal claws* ± equal, 32-40 mm long, 3-4.5(5) mm wide, glabrous, dark pink to crimson; *marginal filaments* (17)20-22(25); *anthers* linear, 2.5-3(3.5) mm long. *Style* thick, tapering towards the tip, glabrous, (20)25-40 mm long; *stigma* small. Summit of *ovary* densely pubescent. *Fruit* sessile, almost ovoid, 15-22 mm long (including thickened calyx-lobes), 10-18 mm wide, smooth (or slightly wrinkled); larger *calyx-lobes* thickened and reflexed, smaller lobes slightly thickened and deflexed; style often persistent in fruit. Fertile *seeds* few to many per capsule, 2-2.5 mm long, linear-cuneate, truncate, angular, glabrous; *testa* dark brown. *Ovulodes* numerous, 1.5-2.5 mm long, linear to linear-cuneate, truncate, angular, glabrous, light brown.

Key to subspecies

- A. Flowers up to 15 in clusters or irregular spikes. Leaves (1)1.5(2) mm wide, glabrous or shortly pubescent (Cape Naturaliste area) 1a. subsp. *graniticus*
 A*. Flowers up to 25 in clusters or irregular spikes. Leaves 0.5-0.8(1) mm wide, glabrous (or if pubescent, only sparsely so at base) (Dwellingup-Collie area).....1b. subsp. *leptophyllus*



Figure 1.—*Calothamnus graniticus* T. J. Hawkeswood subsp. *graniticus*—Holotype (Hawkeswood 110).



Figure 2.—*Calothamnus graniticus* T. J. Hawkeswood subsp. *leptophyllus* (Benth.) T. J. Hawkeswood—Lectotype (Drummond No. 39, K).

1a. subsp. **graniticus** (Figures 1, 3, 4)

Erect, multi-stemmed, much-branched *shrub* to 1.5 m high with thin stems, smooth bark and prominent leaf scars. *Leaves* densely crowded at ends of branches, (2.5)4-7(8) cm long, (1)1.5(2) mm wide, pungent, glabrous or shortly pubescent. *Flowers* 3-15 in clusters or irregular spikes usually on portions of stems from which the leaves have fallen. *Fruit* 15-20 mm long (including thickened calyx-lobes), 13-18 mm wide; *style* often persistent in fruit.

Derivation of name. *Graniticus*, Latin, meaning "living on granite soil", refers to its habit of growing exclusively on granulite based soils.

Habitat. Appears to be restricted to granulite (granite-gneiss) outcrops where it is clearly the dominant species (Figure 3). For further information on this taxon and its ecology and distribution on the Cape Naturaliste Peninsula, see Hawkeswood (in prep.). Flowers May to June.

Distribution. Confined to the Cape Naturaliste Peninsula (33°32'S, 115°01'E) at Meelup Beach, Eagle Bay and the coastline immediately west of the Cape Naturaliste lighthouse to Yallingup (33°38'S, 115°02'E) (Figure 11).

Selected specimens examined. WESTERN AUSTRALIA: Sugar Loaf or Busselton (?), April 1943, B. Peters s.n. (PERTH); near Cape Naturaliste, 12 April 1927, H. G. Elliot s.n. (PERTH); Cape Naturaliste, opp. Sugar Loaf Rock, (33°32'S, 115°00'E), "heath with *Beaufortia*, *Templetonia*, *Leucopogon* and *Melaleuca* species", 24 June 1979, T. J. Hawkeswood 70, 71, 74, 74a, 92, 106, 107, 108 (PERTH); Eagle Bay, Cape Naturaliste (c. 33°31'S, 115°01'E), 23 June 1979, T. J. Hawkeswood and P. Johnson 1, 2, 3, 4 (PERTH); Eagle Bay, Cape Naturaliste, 24 June 1979, T. J. Hawkeswood 75, 76 (PERTH); Little Meelup Beach (33°32'S, 115°01'E), 24 June 1979, T. J. Hawkeswood, 72, 72a, 73, 77, 77a, (PERTH); Little Meelup Beach, 24 June 1979, M. Peterson and T. J. Hawkeswood 1 (PERTH); Opposite Sugar Loaf Rock, 24 June 1979, S. Wilson 1 [2] (PERTH).

Total number of specimens examined: 35.

1b. subsp. **leptophyllus** (Benth.) T. J. Hawkeswood, comb. et. stat nov. (Figure 2)
Basionym: *C. torulosus* Schau. var. *leptophylla* Benth. Fl. Austr. 3: 175 (1867).
Lectotype: Swan River *Drummond*, no. 39 (K, photograph seen, Figure 2) *lecto. nov.*

Erect, multi-stemmed, few-branched *shrub* to 1.5 m high with thin stems, smooth bark, and prominent leaf scars. *Leaves* crowded at ends of branches, (3)4-8(10) cm long, 0.5-0.8(1) mm wide, glabrous or sparsely pilose, especially at base; *oil glands* prominent. *Flowers* 2-25 scattered or arranged in dense spike-like clusters on older stems from which leaves have fallen. Calyx-tube, calyx-lobes, petals, staminal claws, anthers, style and seeds similar to subsp. *graniticus*. *Fruit* wrinkled, often with smooth, irregular bumps, 16-22 mm long (including thickened calyx-lobes), 10-15 mm wide; *style* often persistent in fruit.

Derivation of name. *Leptophyllus*, from Greek, meaning "thin or thread-like" referring to the thin, terete leaves of this subspecies in comparison to the thicker, shorter leaves of subspecies *graniticus*.

Habitat. In *Eucalyptus* woodland on lateritic soils near creeks with *Xanthorrhoea preissii*, *Calothamnus quadrifidus*, and species of *Grevillea*, *Hibbertia* and *Hakea*. Flowers June to August.



Figure 3. Habitat of *Calothamnus graniticus* T. J. Hawkeswood subsp. *graniticus* in Reserve 21629, adjacent to the coastal road at Meelup, Cape Naturaliste. The heath is dominated by *C. graniticus* subsp. *graniticus*, inland plants of which are shorter than those growing nearer the shore. Photo M. Peterson.



Figure 4. Close-up of flowers of *Calothamnus graniticus* T. J. Hawkeswood subsp. *graniticus* at Eagle Bay, Cape Naturaliste. Photo M. Peterson.

Distribution. Only two localities are known at present, namely the Dwellingup area (c. 32°42'S, 116°02'E) and Collie Weir (33°20'S, 116°00'E), (now known as Wellington Dam) (Figure 11).

Other specimens examined. WESTERN AUSTRALIA: Oakley Dam, Dwellingup, 31 May 1972, R. J. Edmiston 5 (PERTH); Oakley Brook, due E of Pinjarra (32°40'S, 115°57'E), 30 April 1979, J. Dodd s.n. (PERTH); near Oakley Dam, Dwellingup, 24 June 1979, M. Peterson 10 [2] (PERTH); Between Dwellingup and Oakley Dam, 24 June 1979, T. J. Hawkeswood and M. Peterson 15 [5] (PERTH); Oakley Dam, Dwellingup (near Dam), 28 Sept. 1979, T. J. Hawkeswood 235 [3], 236 [1] (PERTH); Collie Weir, (33°20'S, 116°00'E), August 1946, F. M. Bennett s.n. (PERTH, CANB, NSW).

Total number of specimens examined: 16.

Comments. *Calothamnus graniticus* is related to *C. rupestris* Schau. (which is found on the western side of the Darling Range east of Perth), the only other species which has petals possessing prominent claws and fruiting capsules with two opposite lobes reflexed while the remaining two are deflexed. *Calothamnus graniticus* differs from *C. rupestris* in having flowers with glabrous, verrucose, calyx-tubes (densely pubescent in *C. rupestris*), longer, less pungent leaves, and flowers with dark pink to crimson staminal claws (pink in *C. rupestris*). Plants of *C. graniticus* tend to have more flowers per cluster than those of *C. rupestris*. *Calothamnus graniticus* subsp. *graniticus* is only found on granulite (granite-gneiss) outcrops on the Cape Naturaliste Peninsula where it has a disjunct distribution and is only locally common. In response to the climatic conditions experienced on the Cape, plants possess thick leaves with a large amount of storage leucoparenchyma tissue. All plants on the western side of Cape Naturaliste possess leaves with close, appressed hairs, while on the eastern side, both glabrous- and hairy-leaved variants grow sympatrically (Hawkeswood in prep.).

Calothamnus graniticus subsp. *leptophyllus* appears to be restricted to the western side of the Darling Range. It seems to favour a rocky habitat on slopes near water-courses and appears to be only locally abundant. It differs from the typical subspecies in having thinner, usually slightly longer leaves which are sometimes glabrous but usually sparsely pubescent (hairs \pm patent). Extensive anatomical investigations (Hawkeswood in prep.) have shown that the leaves have palisade tissue 1 cell deep whereas in subspecies *graniticus*, the palisade is 2 cells thick. Plants of subspecies *leptophyllus* tend to be straggly and multi-stemmed, but few-branched with larger clusters of flowers encircling the stem.

Bentham (1867) regarded subspecies *leptophyllus* as merely a variety of *C. torulosus* Schau. to which it is not closely related. However, in accordance with nomenclature to be adopted in the revision, this taxon has been elevated to a subspecies of *C. graniticus*. The typical subspecies contains larger populations than those of subspecies *leptophyllus*, justifying the name *graniticus* as the species name. In any case, the name *leptophyllus* has no priority outside its rank.

Bentham cited two syntypes for *C. torulosus* var. *leptophylla*, these being Drummond nos. 32 and 39, both in herb. K; the specimen Drummond no. 39 has been chosen as the lectotype for the subspecies since it possesses more fruiting capsules and flower buds. Bentham's confusion with *C. torulosus* may have arisen through neither specimen possessing open flowers.

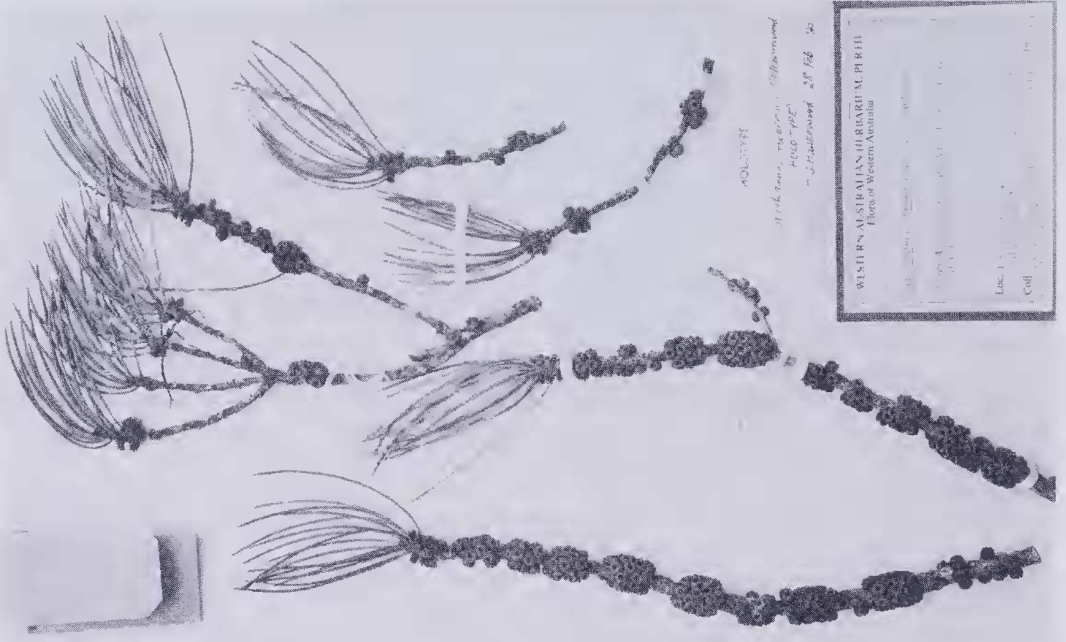


Figure 5.—*Calothamnus tuberosus* T. J. Hawkeswood—Holotype (George 10626).



Figure 6.—*Calothamnus formosus* T. J. Hawkeswood subsp. *formosus*—Holotype (Aplin 3357).

2. *Calothamnus tuberosus* T. J. Hawkeswood, sp. nov. (Figures 5, 7, 11)

Frutex ad 2.5 m altus. Folia linearia, teretia, (3)5-8(12) cm longa, 1.2-2 mm lata, glabra. Flores in dense spicati, (1.5)2-3 cm longi. Calycis tubus (2)2.5-3 mm longus, glaber; calycis lobi 1-1.5 mm longi, glabri. Petala (2.5)3-4 mm longa, ferruginea. Unguis staminalis 22-28 mm longus, 1-1.2 mm latus, glaber; filamentis marginalibus 12-16. Fructus depresso-globularis vel globularis, 4-5 mm longus, (4)5-6(7) mm latus. Semina 0.6-1 mm longa, atro brunnea.

Typus: Peak Charles, (32°53'S, 121°10'E); shrub 4 m; bark papery, flowers red, on granite slope; 10 April 1971, A. S. George 10626 (holo: PERTH).

Erect, compact, much-branched, glabrous, gnarled *shrub* mostly to 2.5 m high. *Young shoots* glabrous. *Leaves* sessile, linear, terete, stiff, erect, (3)5-8(12) cm long, 1.2-2 mm wide, glaucous, mucronate, pungent, glabrous, crowded at ends of branches; oil glands prominent. *Flowers* in dense spikes (1.5)2-3 cm long near the ends of branches amongst leaves or on portions of branches from which leaves have fallen. *Calyx-tube* narrow-campanulate to campanulate, (2)2.5-3 mm long, glabrous or finely pubescent at base only, rhachis dilated at base; calyx-lobes equal, 1-1.5 mm long, erect, acute to slightly obtuse, glabrous outside and within; margins thin, scarious, ciliate. *Petals* broadly elliptic, (2.5)3-4 mm long, obtuse, concave, glabrous, deciduous, orange-brown, papery with thin, scarious, partially ciliate margins. *Staminal claws* equal, 22-28 mm long, 1-1.2 mm wide, glabrous, deep orange-red; marginal filaments 12-16, anthers linear-oblong, c. 1 mm long, dark yellow-brown. *Style* 10-25 mm long, slender, glabrous, stigma small. Summit of *ovary* densely pubescent. *Fruit* sessile, depressed globular to globular, 4-5 mm long, (4)5-6(7) mm wide, smooth, shortly 4-lobed often becoming almost truncate. *Fertile seeds* few per capsule, 0.6-0.8(1) mm long, linear-oblong, truncate (often obliquely), glabrous; *testa* dark brown. *Ovulodes* numerous, linear-oblong to oblong, 0.6-1 mm long, truncate, glabrous, dark yellow-brown.

Derivation of name. *Tuber*, Latin meaning "a swelling" or "tumour", and *-osus*, Latin for "abounding in". Refers to the long, tuberous roots possessed by this species.

Habitat. On granite outcrops or in granitic loam at base of outcrops in open shrubland. Locally common. Flowers September to February depending on climatic conditions of previous season.

Distribution. Barbalin Rock (30°58'S, 118°06'E), Knapp Rock (32°06'S, 120°45'E), Spinifex Rock (31°53'S, 120°39'E), Dog Rock (33°00'S, 121°04'E) and Peak Charles (32°53'S, 121°10'E) (Figure 11).

Other specimens examined. WESTERN AUSTRALIA: Barbalin Rock, 2 Sept. 1969, K. Newbey 2872 (PERTH); Knapp Rock, near Johnston Lake on Hyden-Norseman track, 13 June 1967, A. Kessell 614 (PERTH); Spinifex Rock, Hyden-Norseman track, 8 Feb. 1967, A. Kessell 550 [2] (PERTH); Spinifex Rock, at 330 mile peg on Hyden track, NW of Norseman, May 1966, A. Kessell 263 (PERTH); Dog Rock, 14 June 1972, H. Demarz D3648 (PERTH, KP); Peak Charles, 17 May 1956, A. R. Main s.n. (PERTH); Peak Charles, 18 May 1956, A. R. Main 23715 (PERTH); Peak Charles, July 1964, B. T. Clay and A. R. Main s.n. (PERTH); Peak Charles, 24 Oct. 1964, J. S. Beard 3822 (PERTH, KP); Peak Charles, 18 Sept. 1976, R. J. Hnatiuk 760910 (PERTH); Seedling grown at W.A. Herbarium, 15 Aug. 1978, R. Hnatiuk 780096 (PERTH).

Total number of specimens examined: 15.

Comments. *Calothamnus tuberosus* has no close affinity to any of the other 4-merous species and when the complete revision is published, it will probably be placed in a section on its own. This species has been confused with *C. gilesii* F. Muell. in herbarium collections. *Calothamnus gilesii* has 5-merous flowers, dark green slender leaves mostly 1-1.2 mm wide, hairs at the base of the calyx-tube and almost cylindrical fruit 8-12 mm long and c. 10 mm wide, with two of the lobes prominently thickened and persistent. *Calothamnus tuberosus* has 4-merous flowers, glaucous, succulent leaves 1.2-2 mm wide, usually a glabrous calyx-tube and depressed globular, shortly 4-lobed fruit measuring 4-5 mm long, 5-7 mm wide.

The most characteristic feature of this species is the presence of fleshy, tuberous roots, first recorded by Hnatiuk (1979) who stated that such root structures had not been previously recorded in Australian Myrtaceae. Hnatiuk found during transplantation of seedlings grown in the glasshouse, that they had developed tubers. It appeared from anatomical examination of the tubers (Hnatiuk 1979) that they were well-adapted to store water. In addition, Hnatiuk found that a dried seedling lost water rapidly from the roots whereas the leaves dried out slowly. I have shown (Hawkeswood 1978, in prep.) that terete-leaved species of some genera in the Myrtaceae (e.g. *Melaleuca*, *Eremaea*, *Beaufortia*, *Callistemon* and *Calothamnus*) have leaves with thick cuticles varying from $5\mu\text{m}$ to $15\mu\text{m}$, epidermal cells with thick upper walls encrusted with cutin and often sunken stomates. All these features restrict water loss from leaves.



Figure 7. Habitat of *Calothamnus tuberosus* T. J. Hawkeswood at Peak Charles, with a large plant in the foreground. Photo A. S. George.

Thus it is interesting to ask why *Calothamnus tuberosus* has developed a tuberous habit when the leaves themselves have the capacity to hold water. Specimens of *C. quadrifidus* R. Br. growing sympatrically with the populations of *C. tuberosus* at Peak Charles (32°53'S, 121°10'E) have been examined for tubers by Dr K. W. Dixon (Department of Botany, University of Western Australia, pers. comm.) and none possessed tubers.

Calothamnus tuberosus is locally common on the large granite outcrops of Peak Charles, Dog Rock, Knapp Rock and Spinifex Rock (Figure 7). Another record is from Barbalin Rock (K. Newbey 2872, PERTH), some 350 km NW of Spinifex Rock, which suggests that *C. tuberosus* has a disjunct distribution.

Five-merous species

3. *Calothamnus formosus* T. J. Hawkeswood, sp. nov. (Figures 6, 8, 9, 18)

Frutex usque ad 2.5(4) m altus. Folia linearia, teretia, pilosa, pleraque glabrescenti, vel glabra, (3)4-6(7) cm longa, 0.8-1.2 mm lata, acuminata vel breviter mucronata. Flores 3-15, fasciculati vel dense spicati. Calycis tubus pleraque 4-5 mm longus, glaber vel interum hirsutus; calycis lobi circa 1 mm longi, glabri vel subtiliter pubescentis. Petala 3.5-6 mm longa, oblonga, rosea. Unguis staminalis 22-30 mm longus, 1-1.5 mm latus, glaber; filamentis marginalibus 26-32. Fructus cylindraceus, 6.5-8 mm longus, 5-6 mm latus, pleraque truncatus. Semina circa 2 mm longa, pallido brunnea, ciliata.

Typus: 530 mile peg on road to Denham, (c. 26°20'S, 113°58'E); shrub to 3 feet in tall open shrubland, with *Banksia*, *Grevillea*, *Hakea*, *Plectrachne* and *Eucalyptus*; 11 July 1970, T. E. H. *Aplin* 3357 (holo: PERTH; iso: CANB).

Erect, large, wide, compact, mostly glabrous shrub to mostly 2.5 m high (sometimes 4 m high), with thick bark often splitting on old trunks. Young stems and leaves densely pilose, becoming almost glabrous with age or initially glabrous. Leaves sessile, linear, terete (sometimes biconvex in transection), (3)4-6(7) cm long, 0.8-1.2 mm wide, glabrous or with occasional, scattered, spreading hairs, scabrous or smooth, acuminate-acute or shortly mucronate, sometimes obtuse, not pungent, usually crowded on younger stems at ends of branches or occasionally sparsely scattered on older stems; often conspicuously spotted with large oil glands and irregularly furrowed. Flowers 3-15, arranged in irregular, ± unilateral clusters or dense, short spikes on older stems usually on portions of stems from which the leaves have fallen. Calyx-tube narrowly to broadly campanulate, 4-5 mm long, glabrous or sometimes pubescent; rhachis slightly dilated at the base; calyx-lobes c. 1 mm long, deltoid, acute, slightly concave, erect or slightly spreading, ± glabrous or very shortly pubescent outside, ± glabrous within, thick but with thin, scarious or ciliate margins. Petals 3.5-6 mm long, oblong, obtuse, concave, glabrous, pink, papery with thin, pale, scarious, partially ciliate margins. Staminal claws ± equal, free, glabrous, 22-30 mm long, 1-1.5 mm wide, crimson, pale yellow-green at base near ovary; marginal filaments 26-32; anthers linear, 0.5-0.7 mm long, yellow. Style slender, glabrous, 15-30 mm long; stigma small. Summit of ovary densely pubescent. Fruit sessile, cylindrical, 6.5-8 mm long, 5-6 mm wide, glabrous, truncate or very shortly 5-lobed, covered in short, rounded bullate protuberances, grey-brown; orifice c. 2 mm diameter. Fertile seeds few to many, linear-cuneate, truncate, angled, c. 2 mm long, with transparent cilia on the angles, sometimes curved on one surface; testa light brown. Ovulodes numerous, linear, glabrous, 1.5-2 mm long, smooth, curved, dark brown.



Figure 8. Habit of *Calothamnus formosus* T. J. Hawkeswood subsp. *formosus* west of Hamelin Homestead (Shark Bay area). It occurs sporadically in mallee-heath on red sand. Photo M. Peterson.

Key to subspecies

- A. Leaves mostly 4-6 cm long, usually shortly pilose3a. subsp. *formosus*
 A.* Leaves mostly 7-9 cm long, glabrous3b. subsp. *rigidus*

3a. subsp. **formosus** (Figures 6, 8, 18)

Erect, large *shrub* mostly to 2.5 m high (sometimes 4 m high). *Leaves* terete, (3)4-6(7) cm long, 0.8-1.2 mm wide, scabrous, shortly pilose, older leaves often glabrous. *Calyx-tube* narrowly campanulate, mostly glabrous; *rhachis* dilated at base. *Fruit* 6.5-8 mm long, 5-6 mm wide.

Derivation of name. *Formosus*, Latin, meaning "beautiful on account of form" referring to the large shrub- to tree-like habit of this species.

Habitat. Grows on red sandplains in mallee-heaths with associated species of *Grevillea*, *Hakea*, *Banksia* etc. (Figure 8). Flowers mostly between August and December.

Distribution. Shark Bay area between 26°20'S and 27°10'S, 113°35'E and 114°35'E (Figure 18).

Other specimens examined. WESTERN AUSTRALIA: Tamala Station, May 1960, R. W. Vollprecht s.n. (PERTH); Coburn Station, 15 October 1974, J. S. Beard 7061 (PERTH); 22 miles [35.2 km] W of Hamelin Homestead (26°38'S, 113°55'E), 17

April 1979, *T. J. Hawkeswood*, 20, 48, 49a, 49b, 50, 55 (PERTH); 8 miles E of Tamala Homestead, 20 August 1979, *M. Peterson* 28 (PERTH); 15 km NW of Cooloomia Homestead, (26°50'S, 114°12'E), 18 September 1979, *S. D. Hopper* 1341 [2] (PERTH).

Total number of specimens examined: 13.

3b. subsp. **rigidus** T. J. Hawkeswood, subsp. nov. (Figures 9, 18)

Differt a *C. formosus* subsp. *formosus* foliis glabris laevibus plus rigidis, (6.5)7-9(11) cm longis, fructu leviter latiore et brevior 6-8 mm longo, 5-7 mm lato.

Typus: Murchison River septentrionalem versus ad 424 m.p., (26°33'S, 114°30'E); frutex vel arbor 3.3 m alt.; phalangibus scarlatinus; 30 October 1963, *F. Lullfitz* 2842 (holo: PERTH).

Differs from the typical subspecies in having glabrous, smooth, more rigid leaves (6.5)7-9(11) cm long, 0.8-1.2 mm wide, often with conspicuous oil glands; the calyx-tube slightly more broadly campanulate, with the base covered in white hairs and the rhachis not so prominently dilated at the base; fruit slightly wider and shorter, 6-8 mm long, 5-7 mm wide.

Derivation of name. *Rigidus*, Latin, meaning "hard" or "stiff", refers to the somewhat more rigid leaves possessed by this subspecies in comparison with subspecies *formosus*.

Habitat. Grows on sandplains in mallee-heaths with associated species of *Grevillea*, *Hakea*, *Eucalyptus* etc. Flowers October to December.

Distribution. From near Overlander Roadhouse (26°15'S, 114°20'E) to Yuna (28°20'S, 115°00'E) (Figure 18).

Other specimens examined. WESTERN AUSTRALIA: Near Yuna, 6 December 1958, *C. A. Gardner* 12047 (PERTH); No. 8 tank (via Carnarvon), 5 January 1960, *C. A. Gardner* 12300 (PERTH); 424 mile peg on Carnarvon Highway, 30 October 1963, *F. Lullfitz* L2842 (KP); 425 mile peg on Carnarvon Highway, 3 December 1965, *F. Lullfitz* L4314 (KP); 435 mile peg on Carnarvon Highway, 7 December 1963, *F. Lullfitz* L4550 (KP); S from Carnarvon near 436 mile peg, 29 October 1968, *J. V. Blockley* 1022 (KP); 34 mi S of Wannoo, 17 Sept. 1968, *M. E. Phillips* CBG 035669 (BRI, NSW).

Total number of specimens examined: 10.

Comments. *Calothamnus formosus* is related to *C. blepharospermus* F. Muell. which has more or less cylindrical, truncate fruits covered with short, rounded (bullate) protuberances, and flat, narrow-oblongate leaves. However, *C. formosus* is distinctive in having smaller cylindrical fruits and terete leaves. Another prominent feature is the pink petals. Most specimens examined have had ± glabrous calyx-tubes, but one specimen, lodged at UWA (K. Baird s.n., Carnarvon-Geraldton Road, September 1968) had flowers with densely pubescent calyx-tubes. This specimen may represent another subspecies, but the absence of further material prevents the recognition of such.



Figure 9.—*Calothamnus formosus* T. J. Hawkeswood subsp. *rigidus* T. J. Hawkeswood—Holotype (Lullfitz 2842).



Figure 10.—*Calothamnus hirsutus* T. J. Hawkeswood—Holotype (George 9759).

Both subspecies of *Calothamnus formosus* appear to have a limited distribution in the central western coastal region of Western Australia where they are locally common. No National Parks or Reserves have been set up at present in the areas where they occur. The Shark Bay region contains many endemic plant and animal species, some of which are at present undescribed, and the setting up of a National Park here should ensure the preservation of these rare endemic species.

4. *Calothamnus hirsutus* T. J. Hawkeswood, sp. nov. (Figures 10, 11)

Frutex ad 1 m altus. Folia linearia, teretia, (1.5)2-2.5(3) cm longa, 0.5-0.8 mm lata, longe albo hirsuta. Flores 4-8, fasciculati. Calycis tubus 3-4 mm longus, dense pubescens, calycis lobi 2.5-4 mm longi. Petala 5-6 mm longa, ferruginea. Unguis staminalis (20)25-30 mm longus, circa 1 mm latus, glaber; filamentis marginalibus 20-25. Fructus depresso globularis, 5-6 mm longus, 5-6 mm latus. Semina 0.7-1 mm longa, atrogrisea.

Typus: N of Arrowsmith Lake ($\pm 29^{\circ}30'S$, $115^{\circ}04'E$); spreading shrub 80 cm, flowers red; in sandy loam near swamp; 16 October 1969, A. S. George 9759 (holo: PERTH; iso: CANB, NSW, PERTH).

Low, compact, usually erect, multi-branched, often spreading *shrub* to 1 m high, more or less hirsute; *older stems* glabrous, usually thick and often corky. *Young shoots* densely pilose. *Leaves* sessile, linear, terete, or slightly flattened, crowded, (1.5)2-2.5(3) cm long, 0.5-0.8 mm wide, shortly mucronate but not pungent, sparsely hirsute (hairs \pm perpendicular to leaf, spreading, slender) or sometimes \pm glabrous; *oil glands* randomly distributed and conspicuous. *Flowers* 4-8 in dense, sessile clusters (sometimes unilateral) amongst leaves on older stems. *Calyx-tube* broadly campanulate, 3-4 mm long, densely pubescent; *rhachis* slightly dilated at base; *calyx-lobes* equal, 2.5-4 mm long, erect, acute to slightly obtuse, pubescent outside, shortly pubescent within, margins thin, scarious, ciliate. *Petals* obovate-elliptical, obtuse, concave, 5-6 mm long, glabrous, orange-brown, papery with thin, scarious, ciliate margins. *Staminal claws* \pm equal, (20)25-30 mm long, c. 1 mm wide, glabrous, deep red; *marginal filaments* 20-25; anthers narrow-oblong to oblong, 0.7-1 mm long, dark brown. *Style* 20-28(32) mm long, slender, glabrous; *stigma* small. Summit of *ovary* densely pubescent. *Fruit* sessile, globular, 5-6 mm long, 5-6 mm wide, initially pubescent but becoming glabrous with age, truncate or with one lobe thickened, (often lobes persistent on young fruiting capsules), reflexed; *orifice* c. 2 mm diameter. *Fertile seeds* few to numerous per capsule, 0.7-1 mm long, oblong to narrow-oblong, angles smooth; *testa* dark grey with shallow grooves, outer seeds curved. *Ovulodes* numerous, 0.7-1 mm long, cuneate to narrow-oblong, variously angular, cream.

Derivation of name. Latin *hirsutus*, meaning "shaggy, bristly, prickly" or in botanical Latin, having long hairs. Refers to the long, spreading simple hairs on the leaves.

Habitat. Grows in heath communities on sandplains with species of *Hakea*, *Banksia*, *Eremaea*, *Grevillea* etc. Flowers October to February.

Distribution. From north of Arrowsmith Lake ($29^{\circ}30'S$, $115^{\circ}04'E$) to the Perth suburb of Cannington and to the Helena Valley (Figure 11). At present, there have been no collections made between Perth and the Moore River ($31^{\circ}02'S$, $115^{\circ}50'E$). This may be due either to a disjunct distribution pattern or the result of land clearing for agricultural purposes.

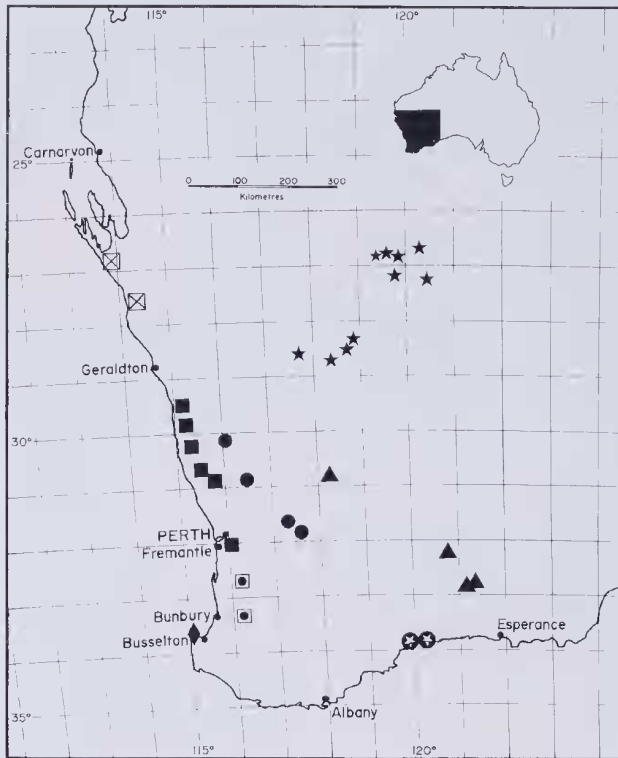


Figure 11. Distribution of the *Calothamnus* taxa—*C. aridus* (★), *C. brevifolius* (●), *C. graniticus* subsp. *graniticus* (◆), *C. graniticus* subsp. *leptophyllus* (◼), *C. hirsutus* (■), *C. kalbarriensis* (⊠), *C. macrocarpus* (⊙), and *C. tuberosus* (▲).

Selected specimens examined. WESTERN AUSTRALIA: 13.3 miles [21 km] N of Cockleshell Gully turn-off to Three Springs, 8 October 1967, W. A. Loneragan 67091 (UWA); Hill River, 22 September 1957, N. H. Speck s.n. (UWA); 1 km E of Lake Indoon, (29°52'S, 115°10'E), 16 December 1976, R. Hnatiuk 761419 (PERTH); Mt Lesueur, 1 November 1973, D. Kitchener 104 (PERTH); Strathmore Road Reserve (no. 26248), S of Badgingarra, (30°34'S, 115°21'E), 5 November 1975, A. S. George 14202 (PERTH); Eneminga Reserve, near Regan's Ford, close to Colin Wedge's property, March 1966, S. W. Bowdler s.n. (PERTH); Moore River National Park, 2 October 1971, R. D. Royce 9503 (PERTH); Darling Range, Perth, April 1901, E. Pritzel NSW 144000 (NSW); Boundary Road, Cannington opposite UWA Botany Dept. Block, 16 November 1977, R. Tinetti s.n. (UWA); Cannington, 21 November 1910, A. Morrison 730 (NSW); Cannington, October 1927, H. Steedman s.n. (PERTH); Cannington, 25 May 1901, A. Morrison s.n. (PERTH); Canning Plains, October 1903, W. V. Fitzgerald NSW 143999 (NSW); Canning Range, 25 February 1903, A. Morrison s.n. (PERTH); Cannington, 2 November 1927, C. T. White 5267 (BRI); Serpentine Dam, 28 September 1979, T. J. Hawkeswood 125 (PERTH); Helena Valley, near Ridge Hill Road, 28 November 1978, J. Seabrook 632 (PERTH); 2.6 miles W of Byford, along Abernethy Road, 20 September 1979, M. Peterson s.n. (PERTH).

Total number of specimens examined: 25

Comments. This species has been confused with *C. villosus* R. Br. in all herbarium collections examined. This error has arisen because knowledge of the true identity of *C. villosus* R. Br. has been previously lacking. The type specimen of *C. villosus* was collected from Lucky Bay (34°00'S, 122°12'E) by Robert Brown who published the name in 1812. Robert Brown also collected and named two other *Calothamnus* species from south-west Western Australia, namely *C. quadrifidus* R. Br. and *C. gracilis* R. Br. These two species were more or less glabrous and since his third species possessed a pubescent calyx-tube, Brown named it *C. villosus*. Thus this name has also been applied to *C. hirsutus* because of its villous characters.

However, *C. hirsutus* is clearly distinguishable from *C. villosus* in having thin, spreading leaves (mostly 2-2.5 cm long) with long, simple, white hairs and depressed globular fruits (often initially truncate but sometimes with one lobe thickened and deflexed across the orifice). This lobe often wears or breaks away on fruits more than one year old resulting in the capsules being truncate. *C. villosus* possesses rigid, smooth or scabrous leaves, mostly 2.5-3.5 cm long, usually glabrous but sometimes sparsely pilose. The fruit is almost ovoid to ellipsoid with two opposite lobes thickened and persistent. *C. hirsutus* has affinities with *C. brevifolius* T. J. Hawkeswood (see under comments on that species).

Calothamnus villosus has a fairly wide distribution from Red Gum Springs in the Stirling Ranges (34°25'S, 119°50'E), Cape Riche (34°36'S, 118°47'E) to the Gairdner and Fitzgerald Rivers, East Mt Barren (33°46'S, 122°01'E) and also occurs to the east of Mt Ragged (33°27'S, 122°28'E). On the other hand, *C. hirsutus* is found from Perth to Arrowsmith Lake (29°30'S, 115°04'E) (Figure 11).

5. ***Calothamnus brevifolius*** T. J. Hawkeswood, sp. nov. (Figures 11, 12, 13, 14)

(?) Synonym: *C. villosus* R. Br. var. *ericifolius* Benth. Fl. Austr. 3:178 (1867). Type: Swan River, James Drummond. 1st Coll. (holo: K, photograph seen).

Frutex ad 0.5 m altus. Folia linearia, teretia, vel leviter applanata (7)8-12(15) mm longa, 0.5-0.8 mm lata. Flores 1-5, dispersi vel breviter et dense fasciculati. Calycis tubus 3.5 mm longus, dense pubescens; calycis lobi circa 2 mm longi. Petala 5-6 mm longa, anguste oblonga, acuta. Unguis staminalis pleraque 20-25(28) mm longus, 0.8-1 mm latus, atroroseus; filamentis marginalibus 15-20. Fructus depresso globularis vel fere cylindraceus, 4-5 mm longus, circa 5 mm latus. Semina 0.7-1 mm longa.

Typus: 11 km E of Piawaning (30°50'S, 116°30'E); in sandy soil on road verge with *Xylomelum angustifolium* and *Banksia prionotes*; 15 February 1980, P. G. Wilson 11711 (holo: PERTH; iso: BRI, CANB, MEL, NSW, PERTH).

Small, erect, spreading, much-branched glabrous *shrub* to about 0.5 m high; the *older stems* with thick bark often splitting. *Young stems* and shoots glabrous. *Leaves* sessile, short, linear, terete (or biconvex in transection), somewhat scabrous, (7)8-12 (15) mm long, 0.5-0.8 mm wide, attenuate at base near rachis, shortly mucronate but not pungent, crowded on younger branches, sometimes loosely scattered; *oil glands* few, scattered (prominent in dried specimens). *Flowers* 1-5, in short, dense clusters encircling stems amongst leaves, or scattered in groups of 1-3, usually on younger branches. *Calyx-tube* narrowly campanulate, 3-5 mm long, densely pubescent, rachis slightly dilated at base; *calyx-lobes* narrow deltoid, acute, slightly concave, not spreading, c. 2 mm long, hirsute outside, closely and shortly pubescent within, thick but with thin, ciliate margins. *Petals* narrow-oblong, 5-6 mm long,



Figure 12. Habit of *Calothamnus brevifolius* T. J. Hawkeswood, on a roadside verge near Piawaning. Photo K. F. Kenneally.



Figure 13. Close-up of branch with flowers and fruit of *Calothamnus brevifolius* T. J. Hawkeswood. Photo K. F. Kenneally.

mostly acute, glabrous, slightly concave, papery with thin, scarious margins. *Staminal claws* \pm equal, 20-25(28) mm long, 0.8-1 mm wide, glabrous, dark pink; *marginal filaments* 15-20; *anthers* narrow-oblong, 0.5-0.7 mm long. *Style* 10-27 mm long, glabrous, slender; *stigma* small. Summit of *ovary* densely pubescent. *Fruit* sessile, depressed globular to almost cylindrical, 4-5 mm long, c. 5 mm wide, truncate or occasionally one of the lobes thickened, persistent and curved into the orifice; pubescence often persistent in mature fruits; *orifice* 1.5-2 mm diameter. *Fertile seeds* small, 0.7-1 mm long, oblong-cuneate with smooth angles, glabrous, truncate; *testa* dull dark brown. *Ovulodes* 0.7-1 mm long, linear-oblong, cuneate, truncate, glabrous, shining yellow-brown.

Derivation of name. *Brevi*, Latin, meaning "short"; *folius*, Latin, meaning "leaved"; refers to the short leaves which are a characteristic feature of this species.

Habitat. In sandy soil with *Xylomelum angustifolium* and *Banksia prionotes* on road verge between Wongan Hills and Piawaning (Figure 12). At Marchagee, the species is a compact shrub to 30 cm tall growing with *Melaleuca acuminata* and *Thryptomene prolifera* heaths as a mosaic in yellow, well drained, sandy loam (B. G. Muir, pers. comm., June 1979). Flowers January to February.

Distribution. Presently only known from a few localities in the southern portion of the Western Australian wheatbelt, namely Piawaning (30°55'S, 116°23'E), Charles Gardner Flora Reserve (31°49'S, 117°32'E), Cunderdin (31°40'S, 117°15'E), near Corrigin (32°20'S, 117°50'E) and in the Marchagee Reserve 23601, (30°00'S, 116°05'E) (Figure 11).

Other specimens examined. WESTERN AUSTRALIA: 0.5 miles [0.8 km] S of Piawaning, January 1968, K. Newbey 3157 (PERTH); S of Tammin, 4 February 1960, T. E. H. Aplin 634 (PERTH); Cunderdin, 3 January 1955, G. M. Storr s.n. (UWA); 19 miles W of Corrigin, 1 January 1964, A. S. George 6052 (PERTH); Marchagee Reserve 23601, c. 10 km N of Marchagee (30°00'S, 116°05'E), 1 June 1977, B. G. Muir 482 (4.7) (PERTH); Charles Gardner Flora Reserve, S of Tammin, 6 April 1966, R. D. Royce 8324 (PERTH).

Total number of specimens examined: 12.

Comments. This species is related to *C. hirsutus* T. J. Hawkeswood, from which it differs in having smaller fruits 4-5 mm long and wide, shorter leaves mostly 8-12 mm long, fertile seeds with dull dark brown testas and ovulodes which are shining yellow-brown. *C. hirsutus* has fruits 5-6 mm long and wide, leaves mostly 2-2.5 cm long, fertile seeds with dark grey testas and cream-coloured ovulodes. Both species have narrow-oblong, \pm acute petals, acute calyx-lobes, pubescent calyx-tubes and occasionally one of the lobes thickened, persistent and deflexed into or across the orifice of the fruit. However, the fruit of both species is usually found to be truncate since the lobe wears or breaks away with age.

Calothamnus brevifolius appears to have a limited distribution, probably as a result of the extensive clearing of land for agricultural purposes in the areas from which it has been collected in the past. A visit was made by the author on 16 February 1980, to Piawaning, (30°55'S, 116°23'E) to check K. Newbey's record of 15 years ago (Newbey 3157, PERTH), but no plants were located after an extensive search by the author and Mr S. Wilson. However, on 15 February, one plant was discovered by Mr P. G. Wilson 11 km E of Piawaning towards Wongan Hills (Figures



HC 1111
Calothamnus brevifolius T. J. Hawkeswood
 (11407421)
 17. J. Hawkeswood 28 Feb. '80

WESTERN AUSTRALIAN HERBARIUM PERTH
 (List of Accessions)

Figure 14.—*Calothamnus brevifolius* T. J. Hawkeswood—Holotype (Wilson 11711).



Calothamnus aridus T. J. Hawkeswood
 (HOLOTYPE)
 17. J. Hawkeswood 6 Feb. 1980

HOLOTYPE

WESTERN AUSTRALIAN HERBARIUM PERTH
 (List of Accessions)

HERBARIUM GARDNERIANUM

MADE AVAILABLE BY THE
 WESTERN AUSTRALIAN HERBARIUM
 TO THE EAST AFRICAN HERBARIUM
 OF THE INTERNATIONAL COMMISSION OF
 NEW ZEALAND, JUNE 1970

WESTERN AUSTRALIAN HERBARIUM
 PERTH

MADE AVAILABLE BY THE
 WESTERN AUSTRALIAN HERBARIUM
 TO THE EAST AFRICAN HERBARIUM
 OF THE INTERNATIONAL COMMISSION OF
 NEW ZEALAND, JUNE 1970

WESTERN AUSTRALIAN HERBARIUM
 PERTH

MADE AVAILABLE BY THE
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 TO THE EAST AFRICAN HERBARIUM
 OF THE INTERNATIONAL COMMISSION OF
 NEW ZEALAND, JUNE 1970

Figure 15.—*Calothamnus aridus* T. J. Hawkeswood—Holotype (Gardner 14434).

12, 13). Mr Wilson also explored the Charles Gardner Flora Reserve South of Tammin on 15 February but due to the dry season most plants in the area were withered and were non-flowering and no *C. brevifolius* plants were located. It is possible that this is a rare species and its continued existence can only be assured in reserves such as Marchagee Reserve 23601, which are set aside for purposes of conservation.

Bentham (1867) described *C. villosus* R. Br. var. *ericifolius*. I have been able to examine a photograph of the type. Although the specimen resembles *C. brevifolius*, it has hirsute leaves, large immature fruits and only a few flowers and buds. Since there is no definite locality on the label, I am hesitant to assign a name to the specimen. In any case, the name *ericifolius* Benth. has no priority outside the rank of variety.

6. *Calothamnus aridus* T. J. Hawkeswood, sp. nov. (Figures 11, 15)

Frutex usque ad 2.5 m altus. Folia linearia, teretia, erecta, (5)7-10(12) cm longa, 0.6-1.2 mm lata, acuminata, glabra, glandibus oleaceis prominentibus ornata. Flores pleraque 2-8(10) conferti super caulibus inter folia positi. Calycis tubus (2)2.5-3 mm longus, glaucus, albo pilosus; calycis lobi 1-1.5 mm longi breviter albo pilosi. Petala auranticae-brunnea, 3-5 mm longa, breviter albo pilosa. Unguis staminalis 20-25 mm longus, circa 1 mm latus, glaber, auranticus vel roseus; filamentis marginalibus 10-12. Fructus depressus globularis, 4-8 mm longus, 5-8 mm latus, glaber. Semina 1.5-2 mm longa, brunnea.

Typus: Between Montague Range and 75 mls N of Sandstone on Wiluna Road, (c. 26°50'S, 119°57'E); bushy, erectly branched shrub 6-8 feet tall; stamens red, anthers yellow; red *Triodia* sand; 22 August 1963, C. A. Gardner 14434 (holo: PERTH; iso: PERTH).

Erect, much-branched, multi-stemmed, straggly to compact *shrub* to 2.5 m high. *Young shoots* glabrous or sometimes finely pilose. *Leaves* sessile, linear, terete, erect, (5)7-10(12) cm long, 0.6-1.2 mm wide, glabrous, narrowed into a thin apex 2-3 mm long (straight or curved), dark to olive green; *oil glands* prominent and randomly distributed. *Flowers* 2-4 (mostly 3) in a cluster or 5-8(10) in a loose spike amongst leaves on younger stems. *Calyx-tube* narrow campanulate to almost cylindrical, (2) 2.5 mm long, glaucous and covered in white hairs; *rhachis* slightly dilated at base; *calyx-lobes* deltoid-obtuse to almost semi-circular, concave, 1-1.5 mm long, with scattered, short, white hairs; *margins* thin, scarious, ciliate. *Petals* obovate, concave, obtuse, 3-5 mm long, thin, covered in short, appressed hairs, orange-brown, persistent; *margins* thin, ciliate. *Staminal claws* ± equal, free, 20-25 mm long, c. 1 mm wide, glabrous, orange-red in lower half to two-thirds, pink-red in upper portion; *marginal filaments* 10-12, pink-red, *anthers* linear, 1-1.3 mm long, yellow or yellow-brown. *Style* slender, 15-26 mm long, glabrous, pink-red, stigma small. *Fruit* depressed globular, 4-8 mm long, 5-8 mm wide, smooth or with irregular bulges or ribs, truncate or shortly five-lobed (lobes usually persistent in young fruit and absent in old, worn fruit). *Fertile seeds* linear-oblong, 1.5-2 mm long, variously angular, often obliquely truncate, glabrous; *testa* dark red-brown. *Ovulodes* similar to fertile seeds, mostly c. 1.5 mm long, slightly paler in colour, usually often obliquely truncate, glabrous.

Derivation of name. *Aridus*, Latin, referring to the arid habitat in which this species grows.

Habitat. Grows in red sand in *Triodia-Eucalyptus* woodland and *Triodia* sandplain associations. Flowers August to October.

Distribution. From Wiluna (26°35'S, 120°14'E), Albion Downs (27°14'S, 120°20'E) and sandplains between the Montague Range and Wiluna, to areas between Sandstone (27°59'S, 119°28'E) and Paynes Find (29°15'S, 117°40'E) (Figure 11).

Other specimens examined. WESTERN AUSTRALIA: W of Sandstone Road, S of Wiluna, sandplain above breakaway, 20 September 1957, *N. H. Speck* 861 [2] (PERTH); 55 miles N of Sandstone, towards Wiluna, 14 October 1972, *R. D. Royce* 10383 (PERTH); 34 miles SW of Wiluna, 29 July 1963, *A. S. George* 5638 (PERTH); rabbit-proof fence, 23 miles S of Meekatharra-Wiluna railway, 28 August 1958, *N. H. Speck* 1318 (PERTH); 10 miles NW of Albion Downs woolshed, 17 September 1958, *N. H. Speck* 1466 (PERTH); 75 miles NE of Paynes Find, 20 August 1974, *H. Demarz* 5106 (PERTH); Youanmi Downs, 26 August 1963, *C. A. Gardner* 14380 (PERTH); No. 1 rabbit proof fence, 340 mile peg, July 1937, *G. F. Melville* 29 [2] (PERTH); Kirkalocka Station on sandplain, 7 miles E of homestead, 24 September 1973, *J. S. Beard* 6655 (PERTH, NSW); 24 miles from Sandstone turnoff, 8 September 1963, *F. Lullfitz* L2400 (PERTH, KP).

Total number of specimens examined: 16.

Comments. *Calothamius aridus* is not closely related to any other known species in the genus. It is the only species which has petals covered in short, appressed, simple hairs (the remaining species have the petal margins ciliate only). The hairy calyx-tube and petals, and the very narrow, erectly held leaves are probably adaptations to the arid environment which this species inhabits.

There is some variation in the size and shape of the fruits on the specimens lodged at PERTH and KP. Fruits vary from 5-6 mm diameter, depressed globular, smooth capsules, to 8 mm diameter depressed globular capsules, slightly wider at the apex than at the base with smooth, rounded ribs.

Many specimens in the W.A. Herbarium (PERTH) have been confused with *C. chrysantherus* F. Muell. The latter species has larger floral parts, more densely pubescent calyx-tube, scabrous leaves, and larger fruits (widest at the base) with prominently thickened calyx-lobes at the apex.

7. *Calothamius macrocarpus* T. J. Hawkeswood, sp. nov. (Figures 11, 16)

Frutex erectus usque ad 2(-3) m altus. Folia linearia, teretia, erecta vel patentia, (1.2)2-2.5(3) cm longa, (1)1.5-2 mm lata, breviter mucronata, glandibus oleaceis prominentibus ornata. Flores 1 vel 2(8) confertis in ramulis supernis inter folia positi. Calycis tubus (3)4-6 mm longus, glaber; calycis lobi 2-2.5 mm longi, glabri. Petala 6-8 mm longa, pallido brunnea. Unguis staminalis 28-35 mm longus, 2-2.5(3) mm latus, glaber, puniceus; filamentis marginalibus (22)26-28(32). Fructus cylindraceus ad fere globularis, 13-17 mm longus, 13-18 mm latus, glaber. Semina circa 4 mm longa.

Typus: West side of East Mt Barren (33°56'S, 120°02'E); shrub 50-80 cm; flowers bright red; in rocky quartzite soil, near summit; 21 April 1962, *A. S. George* 3675 (holo: PERTH; iso: CANB).

Erect, much-branched *shrub* usually to 2 m high but sometimes to 3 m high. *Young shoots* pilose; *older stems* usually glabrous; *younger stems* becoming glabrous with age or sometimes remaining sparsely pilose. *Leaves* sessile, crowded, erect or spreading, linear (sometimes curved), terete, somewhat succulent, (1.2)2-2.5(3) cm

long, (1)1.5-2 mm wide, glabrous or sparsely pubescent, shortly mucronate but not pungent; *oil glands* prominent. *Flowers* usually 1 or 2 together (or occasionally 3 to 8) on stems amongst leaves (but not necessarily axillary). *Calyx-tube* broadly campanulate, (3)4-6 mm long, glabrous; *oil glands* large, conspicuous; *rhachis* slightly dilated at base of calyx-tube; *calyx-lobes* deltoid, obtuse or slightly acute, concave, 2-2.5 mm long, glabrous, centre thickened; *margins* scarious, partially ciliate. *Petals* obovate, 6-8 mm long, obtuse, concave, glabrous, pink to light brown, papery with thin, scarious, partially ciliate margins; *oil glands* prominent in centre. *Staminal claws* \pm equal, free, 28-35 mm long, 2-2.5(3) mm wide, glabrous, crimson; marginal filaments (22)26-28(32); anthers linear, c. 1.5 mm long, yellow. *Style* slender, glabrous, 15-25(30) mm long; *stigma* small. *Ovary* densely pubescent at summit. *Fruit* sessile, large, sometimes almost hidden by dense foliage, cylindrical to almost globular (sometimes slightly wider at base than at apex), 13-17 mm long, 13-18 mm wide, glabrous, smooth, dark brown; *orifice* 3-4 mm diameter; *calyx-lobes* persistent, short, thick, often almost enclosing the orifice. *Fertile seeds* few per capsule, c. 4 mm long, linear, straight or curved, glabrous, shiny, often obliquely truncate at one end, angular (angles sharp); *testa* papery, dark yellow-brown. *Ovulodes* numerous, c. 4 mm long, linear, slightly narrower than the fertile seeds, glabrous, shiny, angular, slightly paler in colour than fertile seeds.

Derivation of name. Greek, *macros* meaning "large" or "long"; Greek *carpos* meaning "fruit"; *macrocarpus* refers to the prominently large, almost globular fruit of this species.

Habitat. Restricted to rocky, quartzite soil in shrubby heath. Flowers August to December, and probably to April (as indicated by data on type specimens).

Distribution. Appears to be restricted to East Mt Barren (33°56'S, 120°02'E) and nearby Culham Inlet (Figure 11).

Other specimens examined. WESTERN AUSTRALIA: NW of East Mt Barren, no date, C. A. Gardner 12096 (PERTH); East Mt Barren, 29 August 1962, C. A. Gardner 14034 [2] (PERTH); East Mt Barren, 25 August 1964, F. Lullfitz L3609 [2] (PERTH); East Mt Barren, 11 October 1967, D. Young Y283 [2] (KP); foot of East Mt Barren, 31 October 1967, J. S. Beard 2195 (KP); East Mt Barren Range, 10 January 1969, H. Demarz D1060 (KP); Culham Inlet, 25 October 1964, K. Newbey 1613 (PERTH).

Total number of specimens examined: 13.

Comments. *Calothamnus macrocarpus* is not closely allied to any other species. The large, cylindrical to almost globular, smooth fruits, which measure 13-17 mm long and 13-18 mm wide, are a distinctive feature. The leaves hold relatively large amounts of water (as clearly evidenced by crushing them) and are conspicuously dotted with large oil glands. This is probably one of the most beautiful species of the genus and has been in cultivation at Kings Park and in Perth residential gardens for a number of years. Although it appears restricted to the East Mt Barren area, its conservation is assured as this lies within the Fitzgerald River National Park.

8. *Calothamnus kalbarriensis* T. J. Hawkeswood, sp. nov. (Figures 11, 17)

Frutex usque ad 1 m altus. Folia linearia, teretia vel breviter applanata, (0.8)1.5-2.5(3.5) cm longa, pleraque 0.8-1(1.5) mm lata, breviter mucronata, glabra. Flores 1-3, fasciculati. Calycis tubus pleraque 4-6 mm longus, pleraque glaber. Petala 6-7 mm

longa, ferruginea. Unguis staminalis (20)25-30 mm longus, 1.5-2 mm latus; filamentis marginalibus (20)25-30. Fructus \pm cylindraceus vel globularis, (8)10-12 mm longus, 10-12 mm latus. Semina 2.5-3 mm longa, brunnea.

Typus: Circa 5 km inland from the Zuytdorf Cliffs, 40 km WSW of Cooloomia Homestead, (27°05'S, 113°56'E); shrub 1 m; in grove of stunted *Eucalyptus erythrocorys* mallees 2-3 m over low heath; yellow sand over massive outcropping of limestone; 15 September 1979, S. D. Hopper 1327 (holo: PERTH; iso: CANB).

Erect, straggly, mostly glabrous *shrub* to 1 m high; branches often with prominent leaf scars. *Young shoots* glabrous or pilose (hairs short, appressed). *Leaves* sessile, linear, terete or slightly flattened, erect or slightly spreading and curved, (0.8)1.5-2.5 (3.5) cm long, 0.8-1(1.5) mm wide, pale green, shortly mucronate, but not pungent, glabrous or with short, appressed, sparse hairs. *Flowers* 1-3 together in small clusters, amongst leaves or on portions of stems from which leaves have fallen; *buds* arising from short, swollen, corky excrescences on the stems. *Calyx-tube* broadly campanulate to almost cylindrical, 4-6 mm long, glabrous or very shortly pubescent; *rhachis* prominently dilated at base; calyx-lobes (2.5)3-4 mm long, almost equal, broadly deltoid, obtuse to slightly acute, glabrous or shortly pubescent outside and inside, thick but with thin, brown, scarios, (often ciliate) margins. *Petals* obovate-elliptical to broadly obovate-elliptical, 6-7 mm long, slightly concave, obtuse, papery, orange-brown, glabrous; *margins* thin, scarios, sometimes partially ciliate; *lamina* dotted with oil glands. *Staminal claws* \pm equal, (20)25-30 mm long, 1.5-2 mm wide, glabrous, dark orange-red; *marginal filaments* (20)25-30; *anthers* linear, c. 1.5 mm long, glabrous, dark brown. *Style* slender, 20-25 mm long, glabrous; *stigma* small. *Fruit* almost cylindrical (often almost globular, slightly wider at base), (8)10-12 mm long (including lobes when present), 10-12 mm wide, sometimes smooth (epidermis peeling with age) but usually rough and corky, often truncate; *lobes* (when present) somewhat corky, erect or incurved. *Fertile seeds* few per capsule, linear-oblong, truncate, 2.5-3 mm long, angular; *testa* brown with a row of transparent cilia on each angle. *Ovulodes* numerous, 2.5-3 mm long, linear, cuneate, truncate, brown, the outer ones curved.

Derivation of name. Named after the township of Kalbarri from where the first collections were made.

Habitat. Grows on sand dunes or shallow sand over limestone in low open mallee heath with species of *Eucalyptus*, *Eremaea*, *Beaufortia*, *Hakea*, *Persoonia* etc. Flowers mostly from August to October.

Distribution. Along the coast from near Tamala Station Homestead (26°42'S, 113°43'E), to the township of Kalbarri (27°42'S, 114°12'E) in the Kalbarri National Park (Figure 11).

Other specimens examined. WESTERN AUSTRALIA: Kalbarri, 20 June 1977, D. R. Bellairs 1666 (PERTH); Sand dunes S of Kalbarri (near Red Bluff) in Kalbarri National Park, 4 August 1979, M. Peterson s.n. (PERTH); 4 miles SE of Tamala Station Homestead (26°44'S, 113°45'E), 27 August 1969, A. S. George 9571 (PERTH).

Total number of specimens examined: 5.

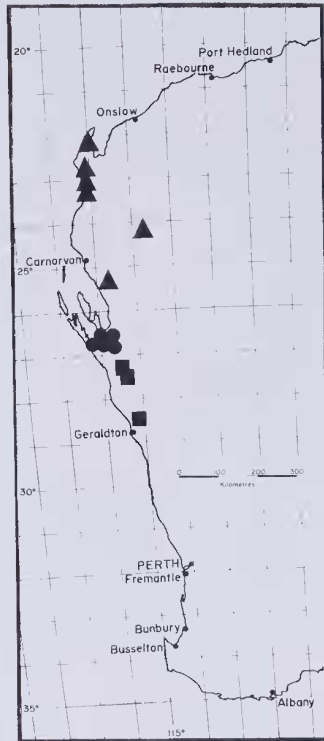


Figure 18. Distribution of the *Calothamnus* taxa—*C. borealis* (▲), *C. formosus* subsp. *formosus* (●), and *C. formosus* subsp. *rigidus* (■).

Comments. The flowers and fruits of *Calothamnus kalbarriensis* resemble those of *C. oldfieldii* F. Muell., however it can be readily distinguished by the shorter, erectly held leaves mostly 1.5-2.5 cm long (4-6 cm long and spreading in *C. oldfieldii*). Both species have fertile seeds with a single row of cilia on each ridge of the testa. The distributions of the two species do not overlap since *C. oldfieldii* is distributed from the Murchison River (27°45'S, 114°15'E) to about 80 km east of Geraldton (28°50'S, 115°30'E) while *C. kalbarriensis* is presently known from Kalbarri (27°42'S, 114°12'E) north along the coast to Tamala Homestead (26°42'S, 113°43'E).

9. *Calothamnus borealis* T. J. Hawkeswood, sp. nov. (Figures 18, 19)

Frutex erectus ad 1 m altus. Folia linearia, teretia, pleraque erecta, (5)7-10(13) cm longa, 1-1.5 mm lata, breviter mucronata, pilosa. Flores fasciculati vel breviter spicati. Calycis tubus pleraque 4-5 mm longus, pubescens; calycis-lobi 2-3 mm longi. Petala circa 5 mm longa, rosea ad ferruginea. Unguis staminalis 20-25 mm longus, 1-2 mm latus, glaber; filamentis marginalibus 20-25. Fructus cylindraceus, 6.5-10 mm longus, 7-10 mm latus, glaber. Semina 2-3 mm longa, pallido brunnea.

Typus: Exmouth Road; spreading shrub 60 cm high, sandy loam; 8 August 1976, Wittwer W1769 (holo: PERTH).

Short, erect, multi-stemmed, spreading *shrub* to about 1 m high, with thick, corky stems; *bark* often decorticating into thin layers at base of plants. *Young shoots* pilose. *Leaves* sessile, crowded, usually erect, terete to biconvex in transection, (5)7-10 (13) cm long, 1-1.5 mm wide, shortly mucronate but not pungent, covered in short, appressed simple hairs, giving a dull grey-green appearance. *Flowers* 1-12, arranged in small clusters or short spikes 1.5-3 cm long, usually on leafy branches. *Calyx-tube* almost campanulate, 4-5 mm long, densely pubescent; *rhachis* slightly dilated at the base of calyx-tube; *calyx-lobes* \pm equal, 2-3 mm long, deltoid, acute to slightly obtuse, thick, pubescent outside, very shortly pubescent inside, margins thin, ciliate. *Petals* obovate, obtuse, concave c. 5 mm long, pink to orange-brown, papery, with thin scarious margins. *Staminal claws* \pm equal, 20-25 mm long, 1-2 mm wide, glabrous; *marginal filaments* 20-25; anthers linear, 0.6-0.8 mm long, yellow. *Style* 10-25 mm long, slender, glabrous; *stigma* small. Summit of *ovary* densely pubescent. *Fruit* sessile, almost cylindrical, slightly wider at base than apex, 6.5-10 mm long, 7-10 mm wide, truncate or very shortly 5-lobed; *orifice* c. 3 mm wide. *Fertile seeds* narrow-oblong, 2-3 mm long, ciliate, angled, often truncate; *testa* chocolate brown. *Ovulodes* linear to narrow-oblong, 2-3 mm long, smooth, truncate, light brown.

Derivation of name. *Borealis*, Latin, meaning "north" or "northern". This is the most northerly distributed species of *Calothamnus* hence the specific epithet.

Habitat. Grows on red sand dunes amongst spinifex or low heath. Flowers July to September.

Distribution. Presently known from the Exmouth region (c. 22°00'S, 114°05'E) to Coral Bay (23°05'S, 113°49'E) with an isolated distribution inland at the Kennedy Ranges (Beard 4375, 24°20'S, 115°10'E) (Figure 18).

Other specimens examined. WESTERN AUSTRALIA: Learmonth Road, 15 miles N of Waroona turnoff, 20 July 1964, *J. S. Beard* 3529 (PERTH, KP); Coral Bay turnoff, 8 August 1976, *H. Demarz* D6107 (PERTH); 56 miles [89.2 km] S of Learmonth, 2 June 1961, *A. S. George* (PERTH); 79 miles [126.4 km] S of Learmonth, 2 June 1961, *A. S. George* 2400 (PERTH); Minilya River, 28 August 1932, *C. A. Gardner* 3208 (PERTH); 6 miles [9.6 km] N of Cardabia Station Homestead, 4 September 1970, *A. S. George* 10212 (PERTH); 80 miles [128 km] NE of Carnarvon, Kennedy Range, near old Merlinleigh Homestead, 23 August 1965, *J. S. Beard* 4375 (PERTH).

Total number of specimens examined: 9.

Comments. *Calothamnus borealis* is not closely related to any other *Calothamnus* species, but has been confused with *C. chrysantherus* F. Muell. in all herbarium collections examined and in vegetation survey publications. This is possibly because of the hairy leaves and flowers with densely pubescent calyx-tubes, two characters which are shared with *C. chrysantherus*. *Calothamnus borealis* differs in having dull grey-green, erectly held leaves with short, appressed hairs, staminal claws 20-25 mm long and smaller fruits 6.5-10 mm long by 7-10 mm wide. *Calothamnus chrysantherus* has mature leaves with scattered, spreading hairs, staminal claws 25-30 mm long and fruits 12-15 mm long by 8-10 mm wide. In addition, the testa of the fertile seed of *C. borealis* is chocolate brown in colour, while it is grey-brown in *C. chrysantherus*.



Figure 19. *Calothamnus borealis* T. J. Hawkeswood—Holotype (Wittwer W1769).

While the distribution of *C. chrysantherus* is clearly defined (Murchison River in the Kalbarri National Park to Northampton), records on the distribution of *C. borealis* are not complete and further collections are required. However, it appears certain that the two species do not overlap and that *C. borealis* has a disjunct distribution in the Kennedy Range.

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